
Server Design FAQ, Version 1.0

**Clarifications and corrections to
Hardware Design Guide Version 2.0
for Microsoft Windows NT Server, a
technical reference for
servers and peripherals for the
Microsoft® Windows NT® Server
operating system**

**Release Version 1.0 - July 2, 1999
Intel Corporation and Microsoft Corporation**

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Introduction and Overview

The *Server Design FAQ* supplements *Hardware Design Guide Version 2.0 for Microsoft Windows NT Server* in providing a guide for engineers who build servers, expansion cards, and peripheral devices that will be used with the Microsoft® Windows® 2000 operating systems. This FAQ is co-authored by Intel Corporation and Microsoft Corporation.

This document is provided as a master list of the “Frequently Asked Questions” for *Hardware Design Guide Version 2.0 for Microsoft Windows NT Server*. This compendium includes all of the FAQs for the document to date, plus additional clarifications and information provided for better understanding. Please note that this document should be read as an addendum to the *Hardware Design Guide Version 2.0*, and not as a separate or standalone document.

The goal for the FAQ is to provide updated information. No new “requirements” are noted in this document over the requirements in *Hardware Design Guide Version 2.0* unless needed to assure platform interoperation with Windows 2000 or as a small evolutionary step in an existing requirement.

In general, the information in this document will go into effect at the same time as the *Hardware Design Guide Version 2.0*. The information in this guide provides guidelines for the testing programs administered by WHQL; where different dates are set for compliance, they are noted specifically in the text.

Hardware Design Guide Version 2.0 for Microsoft Windows NT Server is available on the web at <http://www.microsoft.com/hwdev/serverdg.htm>, and on <http://developer.intel.com>.

Terminology Changes

Operating System Naming

Since the publication of *Hardware Design Guide Version 2.0 for Microsoft Windows NT Server*, Microsoft has announced a naming change for all Windows NT-based operating systems offered after Windows NT 4.0. In summary, the naming changes are as follows:

Old	New
Windows NT 5.0	Windows 2000
Windows NT Server 5.0	Windows 2000 Server
Windows NT Server 5.0, Enterprise Edition	Windows 2000 Advanced Server
(no equivalent)	Windows 2000 DataCenter Server

For a more detailed overview of these name changes, please see <http://www.microsoft.com/windows/news/october1998/win2000.asp>.

For the purposes of this FAQ, readers should map the language in *Hardware Design Guide Version 2.0 for Microsoft Windows NT Server* to the platform naming listed here, with one additional note—either Windows 2000 Advanced Server, Windows 2000 DataCenter Server, or both platforms should be substituted for all usage of Windows NT Server 5.0, Enterprise Edition.

“Alpha” Processor and Architecture References

All references to “DEC Alpha” in *Hardware Design Guide Version 2.0 for Microsoft Windows NT Server* should instead now read as “Alpha architecture.”

Broadening of Coverage for Large Systems

In previous versions of *Hardware Design Guide for Microsoft Windows NT Server*, the guide encompassed the “standard high volume” server with up to and including four processors in a symmetric multiprocessing configuration. However, systems with up to eight processors are now shipping, or are on the verge of shipping, from many vendors. Due to this broadening of the “standard high volume” server market, systems with up to eight processors are now included in the servers that are covered by the *Hardware Design Guide Version 2.0*.

As previously stated, there is no “one to one” mapping of the number of processors in a server to a specific server “class” or “usage model” (for example, one could certainly have a “SOHO Server” with more than one processor); however, in general, it is anticipated that most servers with four or more processors will be most likely viewed as designed to the “Enterprise Server” system considerations.

Future Technology Directions

The “standard high volume” server is evolving rapidly to meet the pace of customer expectations for ever-increasing reliability, availability, serviceability, scalability, usability, and manageability. These increasing customer expectations for the “-abilities” on industry-standard servers mean that future versions of the *Hardware Design Guide* for servers will need to address ever more complex topics.

This section of the document is meant to provide some vision into what those future directions might be and to invite feedback from the industry on these topics. Feedback is also requested for any other issues and topics that should be addressed in the quest for servers that can achieve the highest possible levels of uptime and functionality for any particular segment of server usage. (It is recognized that the balance of cost against features is also an important part of this analysis.)

Some of topic areas that are seen as future work areas for the *Hardware Design Guide* for servers include:

- **ACPI 2.0 and its facilitation of capabilities such as “hot plug” of processors, memory, and I/O subsystems, as well as system partitioning.**
- **System capabilities to isolate failing components at boot time.** The concept of “fault domains,” both at system startup and, where possible, at run time.
- **Future advancements in I/O bus technologies and architectures.** Much exciting work is ongoing in the realm of I/O bus technologies. Future design guides will undoubtedly provide specific requirements and recommendations for each technology area. However, early implementers and adopters of all new bus technologies must comply with all relevant bus specifications, including bus and device power management specifications, for each specific technology as they become available. Additionally, for servers running a Windows 2000 Server family operating system, new bus technologies and devices must comply with the relevant general case guidelines for devices and drivers as articulated in the *Hardware Design Guide* for servers.
- **Enhancements to support for Fibre Channel in Windows operating systems.** As Fibre Channel adoption continues to grow, Microsoft is seeking feedback and input from the industry on the enhancements needed to best support this storage channel in Windows NT-based operating systems. Guidelines relating to use of any enhanced Fibre Channel capabilities in Windows operating systems will appear in future versions of the *Hardware Design Guide* for servers.

- **Use of flash memory as an “emergency boot/recovery” file system.** With the advent of the Windows 2000 command console, system designers may want to consider providing an area of flash memory as an alternate boot device for use with the command console as an emergency recovery aid. The command console provides secure local access to Windows 2000 installations on a specific system, and is NTFS-aware, eliminating the need for Microsoft MS-DOS® as a system maintenance or recovery tool.
- **“Multi-pathing” for storage and network connections.** As part of the efforts to increase platform reliability and availability, eliminating single points of failure wherever possible is extremely valuable. Two areas of future opportunity are allowing “multiple paths” to storage and network connections from servers. Future versions of the *Hardware Design Guide* for servers will provide guidelines on how to provide these capabilities with future Windows operating systems.
- **Advanced usage and support of the Windows 2000 “NMI crash dump capture” capability.** A clarification to guideline # 209 provides some detailed information on the Windows 2000 capabilities to capture crash dump information on NMI.

One way to take advantage of this feature is in “hung system” debugging where a crash capture is triggered via a switch that produces an NMI signal—the technique called out in guideline #209. However, this capability can also be tied to other platform health monitoring capabilities as well.

Some possible areas where this feature could be further leveraged would be in the case where a platform health “watchdog” timer was present. If a watchdog circuit and associated platform management determine that the host platform was in a “hung” state, the watchdog circuit could, as part of the recovery process, ensure that an NMI was asserted to cause a system dump prior to resetting or restarting the system. This process would be a part of root cause analysis support.

Increasingly sophisticated uses of this feature with various forms of remote platform management can also be envisioned; one example might be allowing this feature to be available to system administrators monitoring platform health via remote out-of-band management connections.

- **Enhanced platform health monitoring capabilities.** Customers also have increasing expectations in the area of platform health monitoring—both in terms of monitoring the status of the platform and of its physical “health,” such as internal temperatures, chassis intrusion, fan status, predictive failure analysis, and so on. With the WMI infrastructure now in the Windows family of operating systems, providing such enhanced platform health and monitoring capabilities is made simpler, and future versions of the design guide will continue to enhance requirements and recommendations in these areas.
- **Run-time diagnostics capabilities.** Another core WMI capability is the ability to flag data as “expensive” to collect, which provides a simple mechanism to allow run-time diagnostic capabilities. Future versions of the *Hardware Design Guide* for servers may have additional requirements and recommendations as to the use of these capabilities for enhanced platform self-diagnosis and system health monitoring.

- **Enhancements to “remote management” capabilities.** As industry standard servers running Windows family of operating systems increase their penetration to many more environments with high reliability and availability requirements, customer demands and expectations are increasing for remote management and manageability of these systems.

Certain key capabilities that will likely be addressed in future versions of the *Hardware Design Guide* for servers include requirements for “headless” (that is, without a local display) operations. Some of the concerns that will need to be addressed to fully support headless operation include:

- Remote “power on” and reboot capabilities
- Redirection of pre-operating system firmware displays, such as a pre-operating system BIOS boot or setup screen
- Remoteable screen displays for system startup, normal operation, and crash/error recovery
- Fully-remoteable access to platform management data while the operating system is running, as well as while it is not

As with all of these technology areas, feedback and input from the industry on directions in these areas are actively requested for future *Hardware Design Guides* for servers.

- **Emergence of new server segments.** As servers based on industry standard technologies continue to be deployed more broadly and in support of new tasks, new server designs are emerging. Some of the considerations for these new segments include form factor, consolidation of field-replaceable units, and general physical design issues. Some of these new segments may diverge in some of their serviceability/availability requirements from the standard high volume servers currently addressed by the *Hardware Design Guide*. Intel and Microsoft welcome and invite input from the industry on the new server segments, and on issues that are pertinent for their design and may need to be considered in future versions of the *Hardware Design Guide*.

Legacy Reduction and Removal

The PC platform that is part of the heritage of today's server systems has evolved by adding and retaining technologies. As a result, the evolution and "history" cycle for many technologies imposes a burden that impacts cost, performance, and support—particularly in the server marketplace where PC legacy items reduce the advantages brought by newer technologies. These legacy technologies are present in hardware, firmware, BIOS code, and operating systems.

The *Hardware Design Guide for Windows NT Server* has started to address the transition to newer technologies with Guidelines 50, 57, and 58, among others. In the future, more guidelines will be published to facilitate the continuing migration of older technologies out of the server platform. Making the support of real mode MS-DOS and Windows 95/98 optional for servers, in conjunction with platform firmware evolution, would allow the removal of the Super I/O (SIO) and associated functionality. This removal would include legacy serial ports, PS/2-compatible ports, legacy parallel port, legacy 8259A PIC support, 8042 keyboard controller, and other functions.

The move toward a system firmware strategy that abstracts the hardware interfaces and allows evolution of the underlying platform firmware code will permit substitution of new-for-old equivalent hardware. Such a system firmware model would be platform-neutral. It would also provide a robust infrastructure for industry initiative support, an architectural means for OEM differentiation, and extensibility to support new devices. Removing MS-DOS support will impact the usage of MS-DOS–based utilities for manufacturing and system management. Solutions to those issues will be required before implementation of new guidelines can be complete. In a similar manner, the current use of the serial port for debug will require an effective substitute before the guideline on serial port replacement is effective.

Clarifications and Corrections

New Recommendations

A. NUMA and NUMA-“lite” system designs maintain near:far memory access time ratios of 1:3 or less

Recommended

For optimal performance with Windows 2000 and later versions of Windows NT-based operating systems, it is recommended that system designers building platforms that present memories with different access times keep the ratio for access to “near” versus “far” memories relative to a given microprocessor at a 1:3 ratio or less.

B. System includes USB controller with two USB ports

Recommended

To facilitate the eventual migration away from legacy connections for keyboards, pointing devices, serial devices, and parallel devices, it is recommended that server designers integrate USB functionality into their server platforms. If present, USB ports must comply with the related USB requirements in this guide. Note that this may become a requirement in a future version of the design guide for servers that provide local console access.

C. Systems providing support for WinSock Direct Path (WSDP) connectivity meet requirements for device and driver support

Required

Systems are not required to provide WinSock Direct Path (WSDP) connectivity capabilities. However, those systems that do must meet the following guidelines:

- Networking hardware provides reliable transport in hardware. This is what allows the bypass of the TCP/IP stack in software.
- Provide the necessary software/driver support to facilitate access via the fast alternate paths. This would include the “normal” NDIS 5.0-compliant miniport, plus a System Area Network WinSock provider and a System Area Network

Management driver, as well as a System Area Network TDI provider. Installers for the above components and any needed network management software components must also be provided.

D. PCI-X buses and devices, if present, meet requirements for device and driver support

Required

Systems are not required to provide PCI-X capabilities. However, those systems that do must meet the requirements defined by the PCI-X Version 1.0 or later specification plus other relevant PCI device and driver requirements as defined by this guide.

Clarifications to Existing Text

1. All operating system–controlled hardware complies with these guidelines and is listed on the Windows NT HCL

Required

Clarification, applicable to all systems:

Systems must be tested with the maximum number of processors and maximum amount of memory that the system supports.

2. System and components support dates from the year 2000 and beyond

Required

3. System processor capabilities meet performance requirements for each server class

Required

4. Multiprocessor-capable systems comply with symmetric multiprocessor support specifications and meet minimum expansion requirements

Required for all systems, with Enterprise class supporting expansion to at least 4 processors

Clarification, applicable to all systems:

PCI IRQ Routing on Multiprocessor capable systems : For information about the requirements for PCI IRQ routing on a multiprocessor ACPI system, see “PCI IRQ Routing on a Multiprocessor ACPI System at <http://www.microsoft.com/hwdev/onnow/acpi-mp.htm>.

Multiprocessor Wakeup. A problem has been uncovered with certain multiprocessor systems that will prevent them from properly waking up from a Sleep state under Windows 2000. This pertains to dual-processor or multi-processor systems that transition all processors from an active state to a STPCLK state, and more specifically to systems where all processors receive their STPCLK# request from one source.

Prior to transitioning from a STPCLK state to a Sleep state or lower power state, all processors must generate a Stop Grant Bus cycle. It is essential that all processors have transitioned into the STPGNT state before it is safe to: 1) transition to a lower power state such as Sleep, or 2) externally shut off the processor clocks to allow for flushing buffers, cache maintenance, and other internal activities.

For dual-processor and multiprocessor systems using a single STPCLK to all processors and a single SLP pin to all processors, the transition to the Sleep state should not be used. Behavior of the system during removal of the processor clock—such as transitions from STPCLK to Sleep state—cannot be guaranteed unless all STPGNT bus cycles are received.

For example, *Intel Xeon II Specification*, “Section 4.2.5 Sleep State-State 5,” specifies that for a multiprocessor system, all processors are required to complete the Stop Grant bus cycle before the subsequent 100 BCLK waiting period and before the assertion of SLP# can occur. When multiple processors are serviced by a single STPCLK request to all processors and a single SLP, there is no provision to guarantee that all Stop Grant bus cycles are received before the assertion of SLP.

As another example, in 450NX-based platforms from Intel, the STPCLK# from PIIX4E is connected to all processors, and SLP# from PIIX4E is connected to all processors. The following sequence occurs:

- t0. Operating system writes PMCNTRL register.
- t1. PIIX4E asserts STPCLK#, then waits for Stop Grant acknowledgment.
- t3. The processor acknowledges with Stop Grant ACK cycle.
- t4. PIIX4E asserts SLP# after receiving this.

This sequence works for uniprocessor systems (which is what the PIIX4E was originally designed for). However, in multiprocessor systems, SLP# might be asserted to a processor that is not in Processor Sleep State 3 (that is, not yet acknowledged). This premature SLP# assertion might result in a wakeup problem.

Intel provides additional information about this issue through the Intel Technical Support Hotline at 1-800-628-8686 or 916-377-7000.

For more information, see <http://www.microsoft.com/hwdev/winlogo/99logo.htm>.

5. Installed system memory meets minimum requirements

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	128 MB required	256 MB required	128 MB required
Enterprise:	128 MB required	256 MB required	128 MB required
SOHO:	128 MB required	256 MB required	128 MB required

6. System memory capacity meets minimum requirements

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	512 MB required	2 GB required	512 MB required
Enterprise:	512 MB required	4 GB required	512 MB required
SOHO:	512 MB required	2 GB required	512 MB required

7. System memory includes ECC memory protection

Required

8. System design meets ACPI 1.0 and related requirements

Required for all server types, with additional requirements for SOHO servers

Note: *ACPI Specification, Revision 1.0b* has been published on the ACPI web site at <http://www.teleport.com/~acpi/>; the draft process for Revision 2.0 is underway, as of Q1 1999.

9. Hardware design supports OnNow initiative*Required for all server types, with additional requirements for SOHO servers***10. System startup meets requirements for OnNow support**

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Optional</i>	<i>Optional</i>	<i>Optional</i>
Enterprise:	<i>Optional</i>	<i>Optional</i>	<i>Optional</i>
SOHO:	<i>Required</i>	<i>Required</i>	<i>Required</i>

11. System BIOS meets boot support requirements*Required***Clarification, applicable to all systems:**

This clarification is presented from the perspective of the operating system as it enumerates and configures PCI bridges at system startup time, and deals with how system BIOS can ensure correct configuration of the VGA Enable and ISA Enable bits for support of possible multiple VGA devices installed in a system. For complete details on this topic, please see <http://www.microsoft.com/hwdev/pci/vgacard.htm>.

12. System and device configuration meet Plug and Play requirements*Required***13. Unique Plug and Play ID is provided for each system device and add-on device***Required***14. Option ROMs meet Plug and Play requirements***Optional***15. "PNP" vendor code is used only to define a legacy device's Compatible ID***Required***16. Device Bay controller and devices, if present, meet Device Bay 1.0 and other requirements***Required*

Bus and Device Requirements

17. System provides an I/O bus based on industry standard specification*Required***18. System supports a 32-bit bus architecture***Required***Clarification, applicable to all systems:**

On 32- and 64-bit platforms that provide support for more than 4 GB of system memory, all PCI adapters, including 32-bit PCI adapters, must be able to function properly in the system. In addition, certain classes of adapters, such as those on the primary data path where the majority of network and storage I/O occurs, must also be able to address the full physical address space of the platform. For 32-bit PCI adapters that will be used on the primary data path, this means that the adapter must be able to support the PCI Dual Address Cycle (DAC) command.

Additionally, all 32 bit PCI buses, host bridges, and PCI-to-PCI bridges must also support DAC. These requirements will take effect at a future date no earlier than January 1, 2001, due to the existence of many legacy bridges and devices that do not support DAC cycles.

For 64-bit platforms, all PCI bridges on the motherboard must support DAC for inbound access, and DAC capable devices must not be connected below non-DAC capable bridges, for example, on adapter cards. New 64-bit adapters should be DAC capable. This DAC requirement does not apply to outbound accesses to PCI devices; however, for systems where DAC is not supported on outbound accesses to PCI devices, the system BIOS must not claim that the bus aperture can be placed above the 4 GB boundary.

There are special considerations that system designers must address when using legacy devices, adapters, and bridges in systems that provide support for more than 4 GB of memory. For information on how Windows 2000 Advanced Server and Windows 2000 DataCenter Server will behave in the case where a non-DAC capable bus is detected on a system that supports more than 4 GB of memory, please see <http://www.microsoft.com/hwdev/newPC/PAEdrv.htm>.

19. System supports a 64-bit bus architecture

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Recommended</i>	<i>Optional</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Optional</i>
SOHO:	<i>Recommended</i>	<i>Recommended</i>	<i>Optional</i>

Clarification, applicable to all systems:

64-bit PCI adapters must be able to address any location in the address space supported by the platform.

The server system must support a 64-bit PCI bus if the server has 64-bit processors, or has the capability to support >4 GB of physical memory or is running Windows 2000 DataCenter Server. Additionally, support for a 66 MHz PCI bus is recommended.

20. PCI bus and devices comply with PCI 2.1 and other requirements

Required

Clarification, applicable to all systems:

Note: The PCI SIG has released v2.2 of the *PCI Local Bus Standard Specification*. See <http://www.pcisig.com> for information. PCI 2.2 is expected to become a requirement in the next version of the *Hardware Design Guide* for servers (version 3.0).

Clarification, applicable to all systems with support for >4 GB of physical memory:

Servers which provide support for >4 GB of physical memory and which provide 32 bit PCI bus capabilities must provide support for the PCI Dual Address Cycle command on 32 bit PCI buses, host bridges, and PCI to PCI bridges, and specific classes of PCI adapters as described in guideline 18 “System supports a 32-bit bus architecture.”

Technical Clarification: The system BIOS must correctly configure PCI-to-PCI bridges if the system has a VGA device behind a bridge. Specifically, the BIOS must correctly set the VGA Enable and ISA Enable bits on the bridges, to prevent the bridges from conflicting with each other.

Additional details with illustrated examples of correct configurations of PCI-to-PCI Bridge devices are provided in the white paper titled “Configuring PCI-to-PCI Bridges with VGA Cards,” available on the web at <http://www.microsoft.com/hwdev/pci/vgacard.htm>.

21. System makes a best effort to provide each PCI slot and device type access to a non-shared interrupt line
Required

22. System does not contain ghost devices
Required

23. System uses standard method to close BAR windows on nonsubtractive decode PCI bridges
Required

24. PCI devices do not use the <1 MB BAR type
Required

25. PCI devices decode only their own cycles
Required

26. VGA-compatible devices do not use non-video I/O ports
Required

	Windows NT Server	Enterprise Edition	Small Business Server
27. PCI chip sets support Ultra DMA if primary host controller uses ATA			
Basic Server:	Required	Not applicable	Required
Enterprise:	Required	Not applicable	Required
SOHO:	Required	Not applicable	Required

28. Functions in a multifunction PCI device do not share writable PCI Configuration Space bits
Required

29. Devices use the PCI Configuration Space for their Plug and Play identifiers
Required

30. Device IDs include PCI Subsystem IDs
Required

Clarification, applicable to all systems:

Please refer to <http://www.microsoft.com/hwdev/devdes/pciids.htm> for clarification of frequently asked questions on implementation of the PCI device SID and SVID registers.

31. Configuration Space is correctly populated
Required

32. Interrupt routing is supported using ACPI*Required***Clarification, applicable to Alpha Architecture systems:**

This guideline does not apply to Alpha Architecture systems, as these systems do not provide this information in the ACPI structures.

33. BIOS does not configure I/O systems to share PCI interrupts*Recommended***Clarification, applicable to all systems:**

Recommended for all servers running all versions of Windows 2000 Server.

34. BIOS configures boot device IRQ and writes to the interrupt line register*Required***35. Systems that support hot swapping for any PCI device use ACPI-based methods***Required***Clarification, applicable to all systems:**

For information, see the article on PCI Hot Plug in Windows 2000 that is available at <http://www.microsoft.com/hwdev/pci/hotplugpci.htm>.

36. All 66-MHz and 64-bit PCI buses in a server system comply with PCI 2.1 and other requirements*Required***37. All PCI devices complete memory write transaction (as a target) within specified times***Required***38. All PCI components comply with PCI Bus Power Management Interface specification**

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
SOHO:	<i>Required</i>	<i>Required</i>	<i>Required</i>

Clarification, applicable to all systems:

PCI Bus Power Management Interface Specification, Revision 1.1 or later, is the only industry specification that ensures compatibility with the power management capabilities of Windows 2000, which uses PME# as the wake-up signal.

39. System provides support for 3.3Vaux if system supports S3 or S4 state

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
SOHO:	<i>Required</i>	<i>Required</i>	<i>Required</i>

Clarification, applicable to all systems:

Note: For more information about the related hardware implementation, see “3.3Vaux power delivery/consumption requirements FAQ,” published by the PCI Special Interest Group (PCI SIG) and available at <http://www.pcisig.com>.

40. PCI bus power states are correctly implemented

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
SOHO:	<i>Required</i>	<i>Required</i>	<i>Required</i>

41. All USB hardware complies with USB 1.0 specifications

Required

42. USB connections use USB icon

Required

43. USB devices and drivers support maximum flexibility of hardware interface options

Required

44. USB host controller complies with OpenHCI or UHCI specification

Required

45. System and devices comply with USB power management requirements

Required

46. USB devices comply with their related USB device class specifications

Required

47. USB hubs comply with the USB Specification, Version 1.1

Recommended

48. Bus-powered USB hubs provide ports that can be individually power switched

Required

49. Any subsystems implementing I₂O comply with standards and other requirements

Required

50. System does not include ISA expansion slots

Required

Clarification, applicable to all systems:

ISA slots are no longer allowed in any server class; exemption cases, including out-of-band management devices, are no longer permitted. For WHQL testing programs, this will become effective as of July 1, 2000.

51. System does not include embedded ISA network adapters, storage controllers, or graphics adapters

Required

52. System does not include ISA expansion devices

Required

Clarification, applicable to all systems:

ISA expansion devices, defined here as being an expansion adapter or device installed in an ISA slot, are no longer allowed in any server class; exemption cases, including out-of-band management devices, are no longer permitted. For WHQL testing programs, this will become effective as of July 1, 2000.

53. System includes APIC support

Required

54. Device driver and installation meet Hardware Design Guide requirements

Required

55. Keyboard and mouse connections meet requirements for bus and device classes

Required

56. Serial port meets requirements for bus and device classes

Required

57. Parallel port meets requirements for bus and device classes

Required for all server types, with ECP support required for SOHO servers

Clarification, applicable to all systems:

This requirement presents information that is useful for system designers who wish to incorporate parallel port support within their server designs. There is no requirement that a parallel port be present on a server; designers are strongly discouraged from incorporating parallel ports based on legacy parallel port technologies. However, if a parallel port is present on a server, then it must meet the applicable requirements in this guideline.

58. System includes emergency repair support

Required

59. Primary graphics adapter meets minimum requirements

Required

Networking and Communications Requirements

60. System includes non-ISA NDIS 5.0 network adapter

Required

61. Network adapter uses NDIS 5.0 miniport driver

Required

62. NDIS 5.0 miniport driver supports high-performance send and receive calls

Required

63. Network adapter offloads TCP/IP checksum, IP Security encryption, and TCP message segmentation

Recommended

64. Full-duplex adapter automatically detects and switches to full-duplex mode

Required

65. Adapter automatically senses presence of functional network connection

Required

66. Adapter automatically senses transceiver type*Required***67. Adapter can transmit packets from buffers aligned on any boundary***Required***68. Adapter communicates with driver across any bridge***Required***69. Adapter supports filtering for at least 32 multicast addresses***Required***70. Adapter supports configuration capabilities and registry settings for performance tuning***Required***71. Server network adapter supports remote system setup capabilities***Recommended***Clarification, applicable to all systems:**

This recommendation may become a requirement in a future version of these design guidelines.

72. Network connections used for remote boot meet Net PC v.1.0b requirements for remote system setup*Required***73. PCI network adapter properly supports higher-level PCI commands***Required***74. Adapter and driver support promiscuous mode***Required***75. Adapter and driver support multicast promiscuous mode***Required***76. Network adapter and driver support priority for IEEE 802-style networks***Recommended***77. Device Bay network adapter meets requirements***Required***78. PCI network adapters are bus masters***Required***79. USB or IEEE 1394 network device complies with related device class specifications***Recommended***80. Network device and driver meet Plug and Play and power management requirements.***Required***81. Network communications device supports wake-up events***Recommended***82. System includes modem communications device***Recommended*

83. Modem supports ITU-T V.250, Hayes-compatible command set

Required

Clarification, applicable to all systems:

Windows Unimodem does not use the following commands directly; therefore, these are not in the sample INF and are not required: +ICF, +MA, +EB, +ESR, +ETBM. These commands are only required if the function is controllable in the modem by way of AT commands. In such a case, the standard V.250 commands defined here must be included.

Missing information from the modem section:

Device complies with device class power management

Required

The *Communications Device Class Power Management Reference Specification, Version 1.0* or later, provides definitions for the OnNow device power states (D0—D3) for modems. The specification also covers the device functionality expected in each power state and the possible wake-up event definitions for the class. Power states D0 and D3 cold, including wake on ring support, are required for modems on power managed buses, including PCI and USB. Modem adapters that use the PCI bus must be capable of generating a power management event (PME# assertion) from the D3 cold device state. It is recommended that modem adapters also support capture of Caller ID with hardware support for the AT+VRID “resend caller ID” voice modem command.

Device supports wake-up events

Required

A modem must be able to cause a wake-up event on an incoming ring as defined in *Communications Device Class Power Management Reference Specification*. This applies for modems on all power-managed buses, including PCI and USB. PCI devices are required to support D3 cold on a PCI 2.2-based system with auxiliary power. On all other power-managed buses (such as USB), support for either D2 or D3 is acceptable.

84. Data modem supports PCM (V.90) with V.42 and V.42bis protocol

Required

85. Data modem supports digital connection to support host-side V.90 operation

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

86. Fax modem supports 14.4 Kbps (V.17) with Class 1 (TIA-578-A) command set

Required

87. Fax modem supports adaptive DATA/FAX call classification based on T.32 +FAA

Required

88. Data modem supports V.80 for synchronous access

Required

89. Modem supports adaptive connection, V.25, V.8, and V.8bis call control signaling with V.251 modem commands

Required

90. Modem supports blacklisted and delayed number clearing

Required where applicable

91. Modem supports TDD, meeting V.18-1996 with V.250 AT commands

Recommended

92. Modem controller meets minimum requirements

Required

93. Voice modem support is provided

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	Optional	Optional	Optional
Enterprise:	Optional	Optional	Optional
SOHO:	Recommended	Recommended	Recommended

94. Voice modem supports ITU V.253 (AT+V)

Required

Clarification, applicable to all systems:

This requirement includes support for +VTR (full-duplex voice).

95. ATM adapter meets network adapter requirements

Required

96. ATM adapter supports a minimum number of simultaneous connections

Required

97. ATM adapter supports all service types defined by the ATM Forum

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	Recommended	Required	Recommended
Enterprise:	Recommended	Required	Recommended
SOHO:	Recommended	Required	Recommended

98. ATM adapter supports UBR service type

Required

99. ATM adapter supports a minimum number of simultaneously active VBR or CBR connections

Required

100. ATM adapter supports traffic shaping

Required

101. ATM adapter enforces PCR on UBR virtual circuits

Required

102. ATM adapter and driver support dynamic link speed configuration

Required

103. ATM adapter supports OAM

Required

104. ATM adapter supports buffer chaining (Tx + Rx)

Required

105. ADSL device is implemented as an integrated ADSL modem

Recommended

106. Integrated ADSL modem meets network adapter requirements

Required

107. ATM/ADSL solution is implemented for integrated ADSL modems

Recommended

108. ADSL modem supports DMT line encoding

Recommended

109. ADSL modem supports rate adaptation

Recommended

110. Device is implemented as an integrated cable modem

Recommended

111. Integrated cable modem meets network adapter requirements

Required

112. Integrated cable modem exposes an ATM or Ethernet interface

Required

113. ISDN modem supports required command set

Required

114. ISDN modem exposes both B channels

Recommended

115. ISDN modem supports asynchronous-to-synchronous conversion

Required

116. ISDN modem uses high-speed port

Recommended

117. ISDN modem driver supports unattended installation, with limitations

Required

118. Internal ISDN device meets network adapter requirements

Required

119. Internal ISDN device supports synchronous HDLC framing

Required

120. Internal ISDN device and driver support raw unframed synchronous B channel I/O

Required

121. Driver for ISDN internal device supports unattended installation, with limitations

Required

122. ISDN device with U-interface includes built-in NT-1 capability

Recommended

123. Internal ISDN device has software-selectable terminating resistors*Required***124. Infrared device meets network adapter requirements***Required***125. Infrared device supports both FIR and SIR***Required***126. IrDA hardware reports a unique Plug and Play ID sufficient to support unattended driver installation***Required*

Storage Device Requirements

127. Non-ISA host controllers and devices support bus mastering*Required***128. System and Option ROMs support Int 13h Extensions***Required***129. Block rewritable optical ATAPI device complies with SFF 8070i***Required***130. Controller and peripherals support media status notification***Required*

Technical Correction, applicable to all systems: The intent of this requirement is for devices to support the commands of the implemented bus interface so that the operating system can detect when a media event has taken place. The requirements for removable storage devices are as follows. These requirements apply to both single LUN devices and to devices that are part of a multiple LUN device.

Device Type	Media Status Notification Implementation
All CD or DVD devices (independent of interconnect)	Required. Comply with <i>ANSI NCITS T10 Multi-Media Command Set-2 (MMC-2)</i> standard for Media Status Event Notification.
ATAPI floppy/optical direct access drives (Phase Change, (PowerDrive), Magneto Optical, removable magnetic floppy or rigid based, etc.)	Required. Comply with either MMC-2 standard or SFF 8070i Version 1.1. See PC99:18.24.
IEEE 1394 storage devices (non-CD / DVD)	Required. Comply with <i>NCITS Reduced Block Commands (RBC; T10/97-260r0)</i> standard.
ATA and non-ATAPI (IDE interconnect) storage devices	Required. Comply with <i>Media Status Notification Support, Version 1.03</i> .
Other ATA/ATAPI devices, including tape drives	Recommended. If implemented, comply with <i>Media Status Notification Support Specification, Version 1.03</i> , or SFF 8070i.
Other types of SCSI removable devices	Recommended. If implemented, support based on <i>NCITS Reduced Block Commands</i> standard is

	recommended.
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131. Operating system recognizes the boot drive in a multiple-drive system*Required***132. USB-based mass storage device meets design guide requirements for USB***Required***133. IEEE 1394-based mass storage meets requirements***Required***134. System includes SCSI host controller and SCSI peripherals**

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	Recommended	Required	Recommended
Enterprise:	Recommended	Required	Recommended
SOHO:	Recommended	Required	Recommended

135. SCSI controllers provide multi-initiator support if the controller provides external device connection capability for use as a cluster node*Required***136. SCSI option ROMs support virtual DMA services***Required***137. Bus type is clearly indicated on connectors for all adapters, peripherals, cables, and terminators***Required***138. Differential devices support DIFFSENS as defined in SPI standard***Required***139. Automatic termination circuit and SCSI terminators meet SCSI-3 specification***Required***140. Terminator power is supplied to the SCSI bus, with over-current protection***Required***141. External connector meets SCSI-2 or later specification***Required***142. Controller and peripherals implement SCSI data protection signal***Required***143. SCSI connections use keyed and shrouded connectors***Required***144. External devices use automatic termination, an external pluggable terminator, or an accessible on-board termination switch***Required***145. Shielded device connector meets SCSI-2 or later specification***Required***146. SCAM support is disabled by default***Required***147. Hardware supports the STOP/START UNIT command as defined in the SPI specification***Required*

148. STOP/START UNIT command can be used to decrease power consumption*Recommended***149. SCSI devices that support hot-plugging meet design guide requirements***Required***150. System does not include ATA host controller and peripherals**

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

151. ATA controller and peripherals comply ATA/ATAPI-4 standards*Required***152. Dual ATA adapters use single FIFO with asynchronous access or dual FIFOs and channels***Required***153. System BIOS and devices support LBA if system uses ATA***Required***154. System BIOS supports ARMD***Recommended***Errata:**

The correct title for the ARMD specification is *ATAPI Removable Media Device BIOS Specification, Version. 1.0*. The ARMD specification is available on the web at <http://www.phoenix.com/products/specs.html>.

155. ATA controller and peripherals support Ultra-DMA*Required***Clarification, applicable to all systems:**

ATA and ATAPI devices must meet the following support requirements and recommendations for Ultra DMA and IDE Bus Master DMA.

Support for Ultra DMA:

- Required for ATA controllers and ATA devices
- Recommended for ATAPI peripherals

Support for IDE Bus Master DMA:

- Required for ATA controllers
- Required for ATA devices and ATAPI peripherals, including CD and DVD devices
- Recommended for ATA/ATAPI tape drives
- Recommended for ATAPI removable media drives

156. ATA controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors*Required*

157. ATAPI peripherals comply with ATA/ATAPI-4*Required***158. BIOS enumeration of all ATAPI devices complies with ATA/ATAPI-4***Required***159. ATAPI devices support DEVICE RESET command***Required***160. ISA address ranges 3F7h and 377h are not claimed by ATA controllers***Required***161. ATA/ATAPI device supports ATA STANDBY command***Required***162. System includes Fibre Channel controller and peripherals**

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	Recommended	Recommended	Recommended
Enterprise:	Recommended	Recommended	Recommended
SOHO:	Optional	Optional	Optional

163. SCSI erasable drives support SCSI commands*Required***164. System includes CD drive or other method for installing the operating system***Required***165. CD drive provides 8x or higher performance***Required***Clarification, applicable to all systems:**

This requirement is intended to set the minimum speed needed for production level CD reading on Windows platforms. This requirement applies to the minimum read speed (8x) on any production level CD media, such as application software, at any location on the disc. This requirement does not apply to end user recorded CD data discs, or discs being read in error-correcting, defect management mode. It is expected that OEMs will continue to ship CD drives that produce an acceptable user experience, and conform to the specifications cited in SDG v2.0 guideline #167.

166. CD drive is CD-Enhanced compatible*Required***167. CD drive supports specified logical and physical CD formats***Required***168. ATA/ATAPI CD drive complies with SFF-8020i, v. 2.6***Required***169. CD drive supports multisession and compatibility forms of the READ_TOC command***Required***170. ATA/ATAPI CD changer meets MMC-2 standard***Required*

171. System BIOS or option ROM supports El Torito No Emulation mode*Required***172. CD drive uses push-to-close design***Recommended***173. DVD device provides 2 MB minimum transfer rate or better performance anywhere on the disk***Required***Clarification, applicable to all systems:**

This requirement has been changed to read: “DVD device provides 2 MB minimum transfer rate or better performance.” This requirement is intended to set the minimum speed needed for DVD-Video playback during MPEG-2 decoding on Windows platforms. This requirement applies to the minimum read speed (2 MB/s) on any production level DVD-Video media, at any location on the disc. This requirement does not apply to end user recorded DVD data discs, or discs being read in error-correcting, defect management mode. It is expected that OEMs will continue to ship DVD drives that produce an acceptable user experience, and conform to the specifications cited in SDG v2.0 guideline #175.

174. DVD drive and controller support bus master DMA transfers*Required***175. DVD drive meets minimum compatibility requirements***Required***Clarification, applicable to all systems:**

Recommended: Support for ECMA-274 (+RW) and ECMA-272, 273 (DVD-RAM) and DVD-R.

176. DVD drive meets MMC-2 standard*Required***177. DVD drive uses push-to-close design***Recommended***178. DVD drive supports defect management***Required***179. System meets video playback requirements if DVD drive supports DVD-Video playback***Required***Clarification, applicable to all systems:**

The guideline title, for clarity, is changed to read: “DVD-Video playback, if present, must meet DVD-Video playback requirements.”

The reason for this change is to clarify the fact that servers that provide DVD drives only as storage devices do not have to include the additional capabilities required for DVD-Video playback on a local display device. Only servers that provide the specific feature of DVD-Video playback to the local server display must meet the DVD-Video playback requirements specified in these guidelines.

180. System includes tape drive for local backup*Recommended***181. Single-tape device meets minimum capacity requirements**

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	4 GB required	4 GB required	4 GB required
Enterprise:	8 GB required	8 GB required	8 GB required
SOHO:	4 GB required	4 GB required	4 GB required

~~182. Single-tape device meets minimum speed requirements~~~~20 MB/minute required~~

Guideline #182 has been removed due to obsolescence.

183. Tape device meets industry standards*Required***184. SCSI tape drive supports SCSI commands***Required***185. Win32-based backup solution provided with device***Required***186. CD changer for seven or fewer discs meets MMC-2 standard***Recommended***187. SCSI changer and drive support auto-configuration***Required***188. SCSI tape and optical disk changers support SCSI commands***Required*

Physical Design and Hardware Security Requirements

189. Icons are provided for all external connectors*Required***Clarification, applicable to all systems:**

Color coding is required for server systems, but the color codes listed in *Hardware Design Guide Version 2.0 for Windows NT Server* are only recommended. The intent is to standardize the industry on a single color-coding scheme; these specific colors will become a requirement for systems in future versions of the design guidelines.

For retail peripherals, color-coding is *not* required. However, if color codes for retail peripherals are implemented, the scheme *must* follow the color codes listed in SDG v2.0. For questions and issues about color coding, send e-mail to serverdgmicrosoft.com.

190. All expansion slots in the system are accessible for users to insert cards*Required***191. System and device design include protected switches***Recommended*

192. System design includes locking case*Recommended***193. System and device design include positive retention connectors***Recommended***194. Parallel port design provides sufficient space for connector assembly***Required***195. C2 evaluation for hardware***Recommended***196. Peripherals meet hardware security recommendations***Recommended*

Reliability, Availability, and Serviceability Requirements

197. System includes integrated backup solution*Recommended***198. System includes UPS provided with system***Recommended***199. System includes power supply protection using N+1 (extra unit)**

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

200. System supports replacement of power supplies

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

201. System supports replacement of fans

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	<i>Optional</i>	<i>Required</i>	<i>Optional</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Optional</i>	<i>Required</i>	<i>Optional</i>

202. System includes local hot-swap power supply replacement indicators

	Windows NT Server	Enterprise Edition	Small Business Server
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

203. System supports multiple hard drives

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

Clarification, applicable to all systems:

The guideline title, for clarity, is changed to read: “System supports multiple hard drives.” This is in recognition of the fact that in certain very dense form factor systems, some or all hard drives may be external to the base system chassis but considered part of the server system.

204. System includes intelligent RAID controller with adequate storage capacity

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Optional</i>	<i>Required</i>	<i>Optional</i>

205. System supports at least one of RAID 1, 5, or 1/0

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

206. RAID support includes notification of failed drive

Required

207. RAID subsystem supports automatic replacement of failed drive

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Required</i>	<i>Required</i>	<i>Required</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

208. RAID subsystem supports manual replacement of failed drive

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Required</i>	<i>Required</i>	<i>Required</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

209. System includes protected forced NMI switch for system diagnosis

Recommended

Clarification, applicable to all systems:

For additional information on the “dump switch” support in Windows 2000, which may be helpful for designers of 32-bit systems, please see <http://www.microsoft.com/hwdev/debugging/dmpsw.htm>. Note that this white paper

presents concept suggestions only for designers and is not intended to provide precise implementation detail.

210. System includes alert indicators for occurrence of failure

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

211. Hot-swappable drive includes a local disk drive replacement indicator

Required

212. System includes alert indicators for imminence of failure

	<i>Windows NT Server</i>	<i>Enterprise Edition</i>	<i>Small Business Server</i>
Basic Server:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
Enterprise:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>
SOHO:	<i>Recommended</i>	<i>Required</i>	<i>Recommended</i>

213. Remote new system setup and service boot support uses DHCP and TFTP

Recommended

214. Expansion devices can be remotely managed

Recommended

215. System supports Windows hardware instrumentation implementation guidelines

Required

216. System includes driver support for WMI

Required

217. Management information service provider enabled by default

Required

218. SMBIOS 2.1 or later static table support provided

Recommended

References

This chapter presents all of the specifications and technical references discussed in *Hardware Design Guide Version 2.0 for Windows NT Server*.

1394 Glass Optical Fiber Specification: *Proposal to Extend the P1394.b S-800–S1600 100m Glass Optical Fiber (GOF) Link Specifications*

<http://www.zayante.com/p1394b/GOFmedia/ts980709-GOF-Extension.pdf>

1394 Open Host Controller Interface Specification, Revision 1.0

<ftp://ftp.austin.ibm.com/pub/chrptech/1394ohci/>

1394 Trade Association

E-mail: 1394-sig@1394ta.org

<http://www.1394ta.org>

1394 Trade Association Power Specification Part 1: Cable Power Distribution

1394 Trade Association Power Specification, Part 3: Power State Management

<ftp://ftp.p1394pm.org/pub/p1394pm/>

1997 Version of National ISDN Basic Rate Interface Terminal Equipment Generic Guidelines, Document Number SR-3888

Phone: (800) 521-2673 (North America)

(908) 699-5800 (Outside North America)

<http://www.bellcore.com>

Accelerated Graphics Port Interface Specification, Revision 1.0 and later

<http://developer.intel.com/pc-supply/platform/agfxport/>

Advanced Configuration and Power Interface Specification, Revision 1.0 and later

<http://www.teleport.com/~acpi/tech.htm>

Advanced RISC Computing Multiprocessor Standard Specification, Revision 1.0

<http://www.microsoft.com/hwdev/specs>

An Interoperable End-to-End Broadband Service Architecture over ADSL System

<http://www.microsoft.com/hwdev/publicnet/>

ANSI/SMPTE standards

Recommended Practice (RP) 136 and time-code standard

Society of Motion Picture and Television Engineers

<http://www.smpte.org/stds/stsubj.html>

ANSI, TIA, and other standards

Global Engineering Documents

Phone: (800) 854-7179 (US)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Fax: 1 (303) 397-2740

<ftp://ftp.symbios.com/pub/standards/io/>

ATA/ATAPI specifications and standards

AT Attachment 2 [X3T9.2 948D] and *AT Attachment 3* [X3T10 2008D] standards*ATA/ATAPI-4 Revision 17 Working Draft Standard* (ATA/ATAPI-4)*ATA Packet Interface for CD-ROM* (SFF 8020i)

Other ATA standards

Global Engineering Documents

Fax: (303) 397-2740

Phone: (800) 854-7179 (U.S.)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

ATA and ATAPI draft standards and other working documents are available at

<ftp://fission.dt.wdc.com/pub/standards/> and<ftp://ftp.symbios.com/pub/standards/io/>*ATAPI Removable Media Device BIOS Specification (ARMD), Version 1.0*<http://www.phoenix.com/products/specs.html>*ATM: The New Paradigm for Internet, Intranet & Residential Broadband Services and Applications*, T. Kwok

Prentice Hall, 1998; ISBN 0-13-107244-7

ATM User-Network Interface Specification, Version 3.1

Prentice Hall; 1995 ISBN 0-13-393828-X

<http://www.atmforum.com/atmforum/specs/approved.html>*ATSC DTV Specification*

Other Advanced Television Systems Committee (ATSC) standards

National Association of Broadcasters, (800) 368-5644

Society of Motion Picture and Television Engineers, (914) 761-1100

E-mail: mktg@smpte.orghttp://www.atsc.org/Standards/stan_rps.html*Audio '98 Roadmap**Audio Codec '97 Component Specification**Audio Codec '97 Design Guide papers*<http://developer.intel.com/solutions/tech/audio.htm>*Audio Device Class Power Management Reference Specification, Version 1.0*<http://www.microsoft.com/hwdev/onnow.htm>

Bellcore Technical References

Bellcore (Bell Communications Research)

Phone: (800) 521-2673 (North America)

(908) 699-5800 (Outside North America)

<http://www.bellcore.com>

Communications Device Class Power Management Reference Specification, Version 1.0

<http://www.microsoft.com/hwdev/specs/PMref/PMcom.htm>

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01

<http://www.ptltd.com/techs/specs.html>

<http://www.microsoft.com/hwdev/respec/pnpspecs.htm>

Default Device Class Power Management Specification, Version 1.0

<http://www.microsoft.com/hwdev/specs/Pmref/PMdefault.htm>

Device Bay Specification, Version 1.0

<http://www.device-bay.org>

Device Class Power Management Specifications

<http://www.microsoft.com/hwdev/specs/Pmref/>

Digital Video Interface (DVI) Revision 1.0

<http://www.ddwg.org>

Display Data Channel Standard, Version 3.0, Level 2B protocols

Video Electronics Standards Association (VESA)

Phone: (408) 435-0333

Fax: (408) 435-8225

<http://www.vesa.org/standards.html>

Display Device Class Power Management Specification, Version 1.0

<http://www.microsoft.com/hwdev/specs/PMref/PMdisplay.htm>

DLS Specification, Version 1.0 or later

Downloadable Sounds (DLS) specification

MIDI Manufacturers Association

Fax: (714) 736-9775

E-mail: mma@midi.org

<http://www.midi.org/abtdls.htm>

DTV and broadcast architecture

<http://www.microsoft.com/dtv/>

DVB/DAVIC (Digital Video Broadcasting/Digital Audio-Visual Council)

<http://www.davic.org>

<http://www.dvb.org>

ECMA Standards ECMA-267 (DVD-ROM), ECMA-274 (DVD+RW)
and ECMA-272, 273 (DVD-RAM)

<http://www.ecma.ch>

“Efficient Use of PCI,” Platform Architecture Labs, Intel Corporation

<http://support.intel.com/support/chipsets/pc1001.htm>

EIA Standard #ANSI/EIA-516-88: “Joint EIA/CVCC Recommended Practice for
Teletext: North American Basic Teletext Specification (NABTS)”

Electronic Industries Association

<http://www.tiaonline.org>

El Torito—Bootable CD-ROM Format Specification, Version 1.0

<http://www.ptltd.com/techs/specs.html>

ETSI (European Telecommunication Standards Institute)
<http://www.etsi.fr>

European Telecommunications Standards Institute (ETSI) or Global System for Mobile (GSM) standards
Phone: +33-92 94 42 00
FAX: +33-93 65 47 16
E-mail: secretariat@etsi.fr

Extended Display Identification Data (EDID) Standard, Version 3.0
Video Electronics Standards Association (VESA)
Phone: (408) 435-0333
Fax: (408) 435-8225
<http://www.vesa.org>

FAT32 partition device driver support
<http://www.microsoft.com/hwdev/>

Fibre Channel Association
<http://www.fibrechannel.com>

Home Phoneline Networking Alliance (HomePNA)
<http://www.homepna.org>

Home Radio Frequency (Home RF) Working Group
<http://www.homerf.org>

IBM Personal System/2 Common Interfaces, Part No. S84F-9809
IBM Personal System/2 Mouse Technical Reference, Part No. S68X-2229
International Business Machines Corporation
Order from IBM Customer Publications Support: (800) 879-2755
Or contact an IBM sales representative

ICC Profile Format Specification, Version 3.4,
International Color Consortium
<http://www.color.org/profiles.html>

IEC 61883 Digital Interface for Consumer Electronic Audio/Video Equipment
<https://domino.iec.ch/webstore/webstore.nsf/Welcome?ReadForm>

IEEE 802.14 Cable TV Working Group
<http://www.walkingdog.com/>

IEEE 1394 Standards
ASK*IEEE
Phone: (800) 949-4333
Fax: (212) 310-4091
E-mail: askieee@ieee.org

Global Engineering Documents
Phone: (800) 854-7179 (US)
(613) 237-4250 (Canada)
(303) 792-2181 (Outside North America)
Fax: (303) 397-2740

Implementing Legacy Audio Devices on the PCI Bus
http://www.intel.com/pc-supply/platform/ac97/wp/leg_pci.htm

Information Technology Enhanced BIOS Services for Disk Drives [T13-1226DT]
<ftp://fission.dt.wdc.com/pub/standards/x3t13/project/>

Infrared Extensions to the NDIS Version 4.0 Functional Specification
<http://www.cablemodem.com/>

Infrared Data Association specifications

Serial Infrared (SIR) Physical Layer Specification

Control IR (CIR or IrBUS) Specification

Other Infrared Data Association documents (available only to IrDA members)

Infrared Data Association

PO Box 3883

Walnut Creek, CA 94598 USA

Phone: (510) 943-6546

Fax: (510) 943-5600

E-mail: irda@netcom.com

Instantly Available PC System Power Delivery Requirements and Recommendations Specification

<http://developer.intel.com/design/power/supply98.htm>

Intel hardware developer site

<http://developer.intel.com>

Intel information about IEEE 1394 implementations

<http://developer.intel.com/technology/1394/>

Intel information about USB, including the UHCI design guide for USB

<http://developer.intel.com/design/litcentr/>

<http://developer.intel.com/design/usb/>

International Color Consortium (ICC)

ICC Profile Format Specification

<http://www.color.org>

Interoperability Specification for ICCs and Personal Computer Systems

<http://www.smartcardsys.com>

ISO/IEC 13213:1994 Control and Status Registers (CSR) Architecture for Microcomputer Buses

<http://www.iso.ch/cate/d21416.html>

ISO/IEC DIS 7816 Identification Cards—Integrated circuit(s) cards with contacts Part 1: Physical characteristics

<http://www.iso.ch/cate/d29257.html>

Part 2: Dimensions and location of the contacts

<http://www.iso.ch/cate/d26536.html>

Part 3: Electronic signals and transmission protocols

<http://www.iso.ch/cate/d14735.html>

ITU (International Telecommunication Union) communications standards

ITU Sales

Phone: +41 (22) 730-6141

Fax: +41 (22) 730-5194

E-mail: sales@itu.ch

- <http://www.itu.int/publications/index.html>
- Low Pin Count Interface Specification*
<http://developer.intel.com/design/chipsets/industry/lpc.htm>
- MCNS Data-Over-Cable Service Interface Specifications*
Now DOCSIS Specifications
<http://www.cablemodem.com/>
- Media Status Notification Support Specification, Version 1.03*
<http://msdn.microsoft.com/library/specs/atamed.htm>
<http://www.microsoft.com/HWDev/respec/scsimed.htm>
- Microsoft DirectShow®
<http://www.microsoft.com/directx/pavilion/dshow/>
- Microsoft Windows 95 DDK, Windows 98 DDK, Windows 2000 DDK,
and DirectX® DDK and SDK; Microsoft Platform SDK
MSDN Professional membership
- Microsoft Windows Hardware Compatibility List (HCL)
<http://www.microsoft.com/hwtest/hcl/>
- MMC-2 Multi-Media Command Set-2*
<ftp://ftp.symbios.com/pub/standards/io/t10/drafts/mmc2/>
- Mobile Power Guidelines '99, Revision 1.0*
<http://developer.intel.com/design/mobile/intelpower/>
- MultiProcessor Specification, Version 1.4*
Intel part number 242016-002
<http://developer.intel.com/design/pro/datashts/242016.htm>
- Multisession Compact Disc Specification*
- Enhanced Music CD Specification, Version 1.0*
Philips Consumer Electronics B.V.
Coordination Office Optical-Magnetic Media Systems
Building SWA-109, PO Box 80002
5600 JB Eindhoven, The Netherlands
Fax: (31) (40) 732113
- National Committee for Information Technology Standards (NCITS)*
- Reduced Block Commands (RBC) Draft Proposal T10/97-260r0*
<ftp://ftp.symbios.com/pub/standards/io/t10/drafts/rbc/>
- Network Device Class Power Management Reference Specification, Version 1.0a*
<http://www.microsoft.com/hwdev/specs/PMref/PMnetwork.htm>
- Network PC System Design Guidelines, Version 1.0b*
<http://www.microsoft.com/hwdev/netpc.htm>
<http://developer.intel.com/ial/WfM/design/NETREC.HTM>
- New Key Support for Microsoft Windows Operating Systems and Applications*
<http://www.microsoft.com/hwdev/desinit/scancode.htm>
- NTMS Programmers Guide*
Now: *Removable Storage Management (RSM) Programmer's Guide*
<http://www.highground.com/rsm/rsmprogramming.htm>

- OpenGL conformance rules from the OpenGL Architectural Review Board
<http://www.sgi.com/software/opengl/faq.html>
UseNet news group for OpenGL at comp.graphics.opengl
- OpenHCI: Open Host Controller Interface Specification for USB, Release 1.0a*
<http://www.microsoft.com/hwdev/respec/busspecs.htm>
Specification drafts:
<ftp://ftp.austin.ibm.com/pub/chrptech/1394ohci/>
- OSTA MultiRead Specification for CD-ROM, CD-R, CD-R/RW, and DVD-ROM Devices, Version 1.11*
<http://www.osta.org>
- PC Card Controller Device Class Power Management Reference Specification, Version 1.0*
<http://www.microsoft.com/HWDev/specs/PMref/PMcard.htm>
- PC Card Display Tuple diagnostic utility (Dtpl.exe)
<http://www.microsoft.com/HWDev/busbios/dtpl.htm>
- PC Card Standard Guidelines*
PCMCIA
2635 North First Street, Suite 209
San Jose, CA 95134 USA
Phone: (408) 433-2273
Fax: (408) 433-9558
E-mail: office@pcmcia.org
<http://www.pc-card.com/bookstore.htm>
- PC/Smart Card (PC/SC) Workgroup
<http://www.smartcardsys.com>
- PCI information, including Microsoft testing tools, specifications, white papers and other related articles
E-mail: pciinfo@microsoft.com
<http://www.microsoft.com/hwtest/>
<http://www.microsoft.com/hwdev/pci/>
- PCI specifications
PCI Bus Power Management Interface Specification, Revision 1.0 and later
PCI Bus Power Management Interface Specification for PCI to CardBus Bridge, Revision 1.0
PCI Local Bus Specification, Revision 2.1 (PCI 2.1) and later
PCI to PCI Bridge Specification, Revision 1.0.
PCI SIG
Phone: (800) 433-5177
<http://www.pcisig.com/specs.html>
- PCMCIA standards
PCI to PCMCIA CardBus Bridge Register Description (Yenta specification)
PCMCIA
2635 North First Street, Suite 209
San Jose, CA 95134 USA
Phone: (408) 433-2273

Fax: (408) 433-9558
E-mail: office@pcmcia.org
<http://www.pc-card.com/bookstore.htm>

Personal Computer Audio Quality Measurement Definitions by Dr. Steven Harris and Cliff Sanchez, Crystal Semiconductor

<http://www.cirrus.com/products/papers/meas/meas.html>

Plug and Play specifications

Plug and Play External COM Device Specification, Version 1.0

Plug and Play Industry Standard Architecture (ISA) Specification, Version 1.0a and
Clarification to Plug and Play ISA Specification, Version 1.0a

Plug and Play Parallel Port Device Specification, Version 1.0b

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<http://www.microsoft.com/hwdev/respec/pnpspecs.htm>

<http://msdn.microsoft.com/library/>

QIC 157, Revision D

Quarter-Inch Cartridge (QIC) Drive Standards

<ftp://fission.dt.wdc.com/pub/standards/QIC/QIC157>

SCSI draft standards and other working documents

<ftp://ftp.symbios.com/pub/standards/io/t10/>

SFF 8090 (Mt. Fuji specification)

Other SFF Committee publications and specifications

FaxAccess: (408) 741-1600 (fax-back)

Fax: (408) 867-2115

<ftp://fission.dt.wdc.com/pub/standards/SFF/specs/>

Simple Boot Flag Specification, Version 1.0

http://www.microsoft.com/hwdev/desinit/simp_bios.htm

Small Computer Interface (SCSI-2) [X3T9.2-375R] standard

Small Computer Interface (SCSI-3) Parallel Interface (SPI) [X3T9.2/91-10] standard

Other SCSI standards and documents

Global Engineering Documents

Fax: (303) 397-2740

Phone: (800) 854-7179 (U.S.)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Small Form Factor (SFF) Committee publications

FaxAccess: (408) 741-1600 (fax-back)

Fax: (408) 867-2115

Smart Battery specifications

Smart Battery Charger Specification, Version 1.0

Smart Battery Data Specification, Version 1.0

Smart Battery Selector Specification, Version 1.0

Smart Battery System Manager Specification, Version 1.0

<http://www.sbs-forum.org/specs/index.html>

SMART IOCTL API Specification, Version 1.1

<http://msdn.microsoft.com/library/specs/iocltapi.htm>

Standard Signaling Method for a Bi-directional Parallel Peripheral Interface for Personal Computers (IEEE 1284 specification)

ASK*IEEE

Phone: (800) 949-4333

Fax: (212) 310-4091

Global Engineering Documents

Fax: (303) 397-2740

Phone: (800) 854-7179 (US)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Storage Device Class Power Management Reference Specification, Version 1.0

<http://www.microsoft.com/hwdev/specs/PMref/PMstore.htm>

System Management BIOS Reference Specification, Version 2.2

<ftp://download.intel.com/ial/wfm/smbios.pdf>

<http://www.phoenix.com/techs/specs.html>

Unimodem Diagnostics Command Reference Specification

<http://www.microsoft.com/hwdev/respec/commspec.htm>

Universal Disk Format Specification, Version 1.5 and 2.0

<http://www.osta.org>

Universal Serial Bus PC Legacy Compatibility Specification, Version 0.9

http://www.teleport.com/~usb/data/usb_le9.pdf

USB specifications and USB Implementers Forum:

USB Class Definitions for Communications Devices, Version 1.0

USB Common Class Base Specification, Revision 1.0

USB Device Class Definition for Audio Devices, Version 0.9

USB Device Class Definition for Human Interface Devices (HID), Version 1.0

USB Device Class Definition for Mass Storage Devices, Revision 1.09

USB Device Class Definition for Printing Devices, Version 1.0

USB HID Usage Tables, Version 1.0

USB Imaging Class Specification

USB Monitor Control Class Specification, Revision 1.0

USB PC Legacy Compatibility Specification, Revision 0.9

USB Specification, Version 1.0 or later

USB Usage Tables for HID Power Devices, Release 1.0

Phone: (503) 264-0590

Fax: (503) 693-7975

<http://www.usb.org/developers/index.html>

*VESA BIOS Extension Standard/Core Functions 2.0 (VBE/Core 2.0)**VESA Display Data Channel Standard**VESA and Industry Standards and Guidelines for Computer Display Monitor Timing**VESA Video Interface Port (VIP) Specification*

Video Electronics Standards Association (VESA)

Phone: (408) 435-0333

- Fax: (408) 435-8225
<http://www.vesa.org/standards.html>
- Video Essentials test disc from Joe Kane Productions, Inc.
<http://www.videoessentials.com>
- Video-Ready Modem Handbook Specification, Version 1.0*
<http://developer.intel.com/IAL/vidred.htm>
- Web-Based Enterprise Management (WBEM) information
<http://www.dmtf.org/wbem/>
<http://www.microsoft.com/management/wbem/>
- White papers and guidelines for Microsoft operating systems
- Audio: <http://www.microsoft.com/hwdev/audio.htm>
- CardBus: <http://www.microsoft.com/hwdev/cardbus/>
- DirectDraw VPE and kernel-mode video transport:
<http://www.microsoft.com/hwdev/devdes/vpe.htm>
- Display and Video Technology: <http://www.microsoft.com/hwdev/video/>
- DTV: <http://www.microsoft.com/dtv>
- IEEE 1394: <http://www.microsoft.com/hwdev/1394/>
- I/O Ports and Devices: <http://www.microsoft.com/hwdev/input/>
- Modem, Unimodem: <http://www.microsoft.com/hwdev/modem/>
- Multiple-monitor/multiple-adaptor support:
<http://www.microsoft.com/hwdev/video/>
- NDIS and Windows networking white papers:
<http://www.microsoft.com/communications/>
<http://www.microsoft.com/hwdev/network/>
- Printing: <http://www.microsoft.com/hwdev/print/>
- Still Image Architecture: <http://www.microsoft.com/hwdev/stillvideo/>
- Storage: <http://www.microsoft.com/hwdev/storage/>
- Telephony API (TAPI) overview:
<http://www.microsoft.com/communications/telephony.htm>
- USB: <http://www.microsoft.com/hwdev/usb/>
- Video and Broadcast Components: <http://www.microsoft.com/hwdev/bpc/>
- WDM driver support: <http://www.microsoft.com/hwdev/wdm/>
- WMI: <http://www.microsoft.com/hwdev/manageability/>
- Windows Hardware Instrumentation Implementation Guidelines (WHIIG), Version 1.0*
<http://www.microsoft.com/hwdev/desguid/whiig.htm>
- Wired for Management Baseline Specification*
- Version 1.1a—<http://developer.intel.com/ial/WfM/design/BIBLIOG.HTM>
- Version 2.0—<http://developer.intel.com/ial/wfm/>

Yenta specification

PCI to PCMCIA CardBus Bridge Register Description

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2635 North First Street, Suite 209

San Jose, CA 95134 USA

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Fax: (408) 433-9558

E-mail: office@pcmcia.org

<http://www.pc-card.com/bookstore.htm>